JULIA BUTLER HANSEN WILDLIFE REFUGE
SEDIMENT QUALITY EVALUATION
REPORT

November 2006

Prepared by:
Kathryn Barko

Technical Review:
Tim Sherman

Portland District
Corps of Engineers
CENWP-EC-HR

US Army Corps
of Engineers®
Portland District

Acronyms

JBH	Julia Butler Hansen Wildlife Refuge
EPA	Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
ODEQ	Oregon Department of Environmental Quality
WDOE	Washington Department of Ecology
WDNR	Washington Department of Natural Resources
IDEQ	Idaho Department of Environmental Quality
NMFS	National Marine Fisheries Service
USFWS	U.S. Fish and Wildlife Service
DMEF	Dredge Material Evaluation Framework
SEF	Sediment Evaluation Framework for the Pacific Northwest
TOC	Total Organic Carbon
PCB	Polychlorinated Biphenyl
MDL	Method Detection Limit
MRL	Method Reporting Limit
ND	non-detect
ppm	parts per million – mg/kg
ppb	parts per billion – ug/kg & ug/L
SL	Screening level
Sb	Antimony
As	Arsenic
Ca	Calcium
Cd	Cadmium
Cu	Copper
Pb	Lead
Hg	Mercury
Ag	Silver
Zn	Zinc

Table of Contents

Introduction

The purpose for sampling the sediment quality at Julia Butler Hansen Wildlife Refuge (JBH) was to characterize existing conditions at eight locations within the refuge and determine the presence and nature of contamination in sediments preceding proposed ecosystem restoration within the refuge. The proposed restoration would entail the replacement of 4 existing and the installation of 4 new tidegates and culverts at 8 sidechannel outlets (sloughs) located within the refuge. Sediment samples were collected at all 8 sloughs within JBH as discussed below. The proposed project would improve water exchange and water quality conditions within the refuge and enhance the habitat of endangered salmonids, Columbian White tailed deer, and other species.

Sampling Methods

Surface sediment samples were collected using a petite ponar at the sites listed in Table 1 and shown in Figure 1 below. Sediment was collected at each site, on both the right and left hand side of the road/levee and combined into one sample per site. In other words, sediment was collected at the internal slough (within the refuge) and the external slough (that connects to the Columbia River) and mixed together into one sample at each site (Table 1 and Figure 1). All eight samples were analyzed for the following parameters: chlorinated herbicides (EPA 8151A), organochlorine pesticides (EPA 8081A), PCBs (EPA 8082), physical grain size, total metals, and TOC (EPA 9060). The sediment samples were collected using laboratory provided sample containers, packed in ice, and delivered to the laboratory and analyzed within the specified holding times.

Table 1. Water Quality and Sediment Sampling Locations, Julia Butler Wildlife Refuge, July 26, 2006

Site Identifier	Site Name	Latitude	Longitude
JBH-G-01	Indian Jack Slough	46 ° 13’ 52.1”	123 ° 23’ 56.7”
JBH-G-02	Duck Lake Slough	46 ° 14’ 17.5”	123 ° 24’ 45.1”
JBH-G-03	Ellison Slough	46 ° 14’ 38.2”	123 ° 25’ 30.2”
JBH-G-04	Steamboat/Winter Slough	46 ° 15’ 17.8”	123 ° 26’ 8.9”
JBH-G-05	Unnamed 5 (Greg’s Slough)	46 ° 15’ 34.4”	123° 26’ 25.3”
JBH-G-06	Unnamed 6 (Jeremy’s Slough)	46 ° 16’ 5.3”	123 ° 26’ 48.6”
JBH-G-07	Hampson Slough	46 ° 15’ 32.7”	123 ° 25’ 33.3”
JBH-G-08	Pump Plant (Brook’s Slough)	46 ° 15’ 27.2”	123 ° 25’ 6.5”

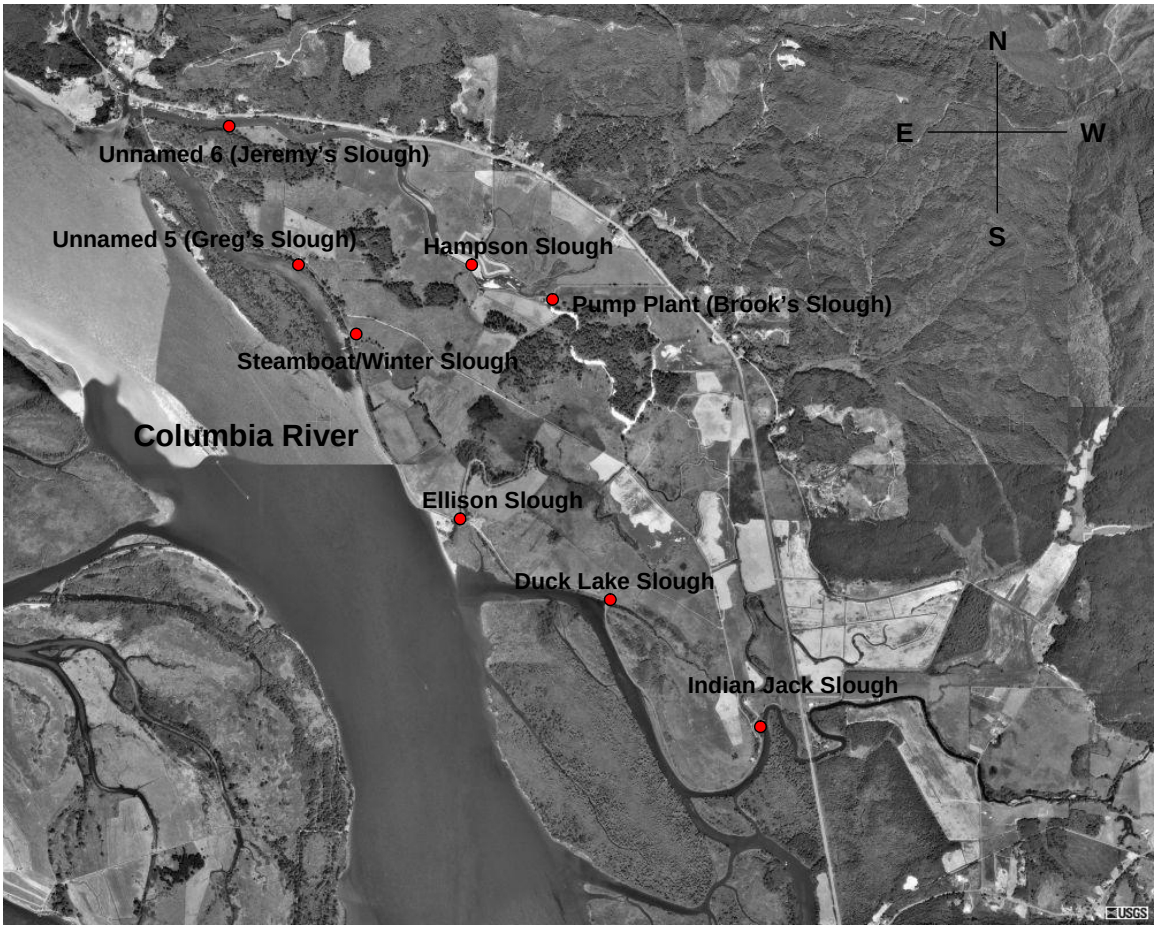

Figure 1. Aerial photograph of Julia Butler Hansen Wildlife Refuge, 8 meter resolution.

Results

Collection and evaluation of the sediment data was completed using guidelines from the Dredged Material Evaluation Framework (DMEF) and the Sediment Evaluation Framework for the Pacific Northwest (SEF). The DMEF is a regional manual developed jointly with the following regional agencies: The Environmental Protection Agency (EPA), The US Army Corps of Engineers (USACE), The Oregon Department of Environmental Quality (ODEQ), and the Washington Department of Ecology and Natural Resources (WDOE and WDNR). This document is guidance for implementing the Marine Protection Research and Sanctuaries Act and the Clean Water Act, Section 404 (b) (1). The SEF is a consolidated and revised version of the existing Dredged Material Evaluation Framework manual and provides a framework for the assessment and characterization of freshwater and marine sediments in Idaho, Oregon, and Washington (defined as Pacific Northwest). The SEF was developed by the following agencies: The Environmental Protection Agency (EPA), The U.S. Army Corps of Engineers (USACE), The Oregon Department of Environmental Quality (ODEQ), the Washington Department of Ecology and Natural Resources (WDOE and WDNR), the Idaho Department of

Environmental Quality (IDEQ), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS).

Sediment samples were compared to DMEF and SEF screening levels in order to determine if the chemicals indentified pose a risk to aquatic biota and/or human health. Laboratory analytical results are presented in tabular format throughout this report.

Chlorinated Herbicides (EPA Method 8151A)

The chlorinated herbicides 2,4-D and 2,4-DB which are used to control broad-leaf weeds in agriculture, were found in small amounts at sites JBH-G-02 or Duck Lake Slough, JBH-G-05 or Unnamed 5 (Greg's Slough), JBH-G-07 or Hampson Slough, and JBH-G-08 or Pump Plant (Brook's Slough). All amounts of chlorinated herbicides measured were estimated by the lab due to such low concentrations detected in each sample (Table 2). Furthermore, all herbicides detected were well below the MRL or method reporting limit.

Table 2. Chlorinated Herbicides (µg/kg) analyzed from sediment samples, Julia Butler Hansen Wildlife Refuge, July 26, 2006

	Site Identifiers							
Analyte, mg/kg	**JBH-G-01**	**JBH-G-02**	**JBH-G-03**	**JBH-G-04**	**JBH-G-05**	**JBH-G-06**	**JBH-G-07**	**JBH-G-08**
Dalapon	<51 u	<57 u	<22 u	<28 u	<37 u	<37 u	<33 u	<44 u
Dicamba	<16 u	<18 u	<6.6 u	<8.5 u	<12 u	<12 u	<9.9 u	<14 u
MCPP	<8400 u	<9400 u	<3600 u	<4600 u	<6000 u	<6100 u	<5300 u	<7200 u
MCPA	<14000 ui	<11000 u	<4200 u	<5400 u	<7100 u	<7100 u	<6200 u	<8500 u
Dichlorprop	<12 u	<35 ui	<4.8 u	<6.2 u	<8.1 u	<8.2 u	<7.1 u	<9.7 u
2,4-D	<14 u	<110 ui	<6.1 ui	<7.8 ui	19 j	<10 u	13 j	26 j
2,4,5-TP (Silvex)	<12 u	<13 u	<4.8 u	<6.2 u	<8.1 u	<8.2 u	<7.1 u	<9.7 u
2,4,5-T	<12 u	<14 u	<4.9 u	<6.4 u	<8.4 u	<8.4 u	<7.4 u	<10 u
2,4-DB	<13 u	84 jp	<5.4 u	<7.0 u	<9.2 u	<37 ui	19 jp	<11 u
Dinoseb	<58 u	<66 u	<25 u	<32 u	<42 u	<42 u	<37 u	<50 u

Qualifier Codes:
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
U = The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
I = The MRL/MDL has been elevated due to a chromatographic interference.
P = The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results (25% for CLP Pesticides).
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
Note: No screening levels have been developed for these contaminants due to their relatively short half-life.

Organochlorine Pesticides (EPA Method 8081A), PCBs (EPA Method 8082)

Even though the majority of organochlorine pesticides have been banned for use within the United States they are still found in soils and waters country wide due to their persistence and lengthy half-life. Small amounts of these broad spectrum pesticides were

found in five of the eight sediment samples collected at Julia Butler Hansen Wildlife Refuge, however, all contaminants detected were below DMEF and SEF screening levels (Table 3). The organochlorine pesticide 4,4'-DDT was detected in the sediment sample collected at site JBH-G-01 or Indian Jack Slough but, as stated above, was below the DMEF screening level of 6.9 mg/L. The pesticide 4.4'-DDE was detected in the sample from site JBH-G-02 or Duck Lake Slough, while no pesticides were detected in the JBH-G-03 (Ellison Slough) sample. Four pesticides including Heptachlor, 4,4'-DDE, 4, 4'-DDD, and 4,4'-DDT were detected in small amounts in the Steamboat/Winter Slough sample. 4,4'-DDE and 4,4'-DDD were detected in the JBH-G-05 or "Unnamed 5 (Greg's Slough)" sediment sample while only 4,4'-DDE was detected in the "Unnamed 5, (Jeremy's Slough)" sample. No organochlorine pesticides were detected in the samples collected at Hampson Slough or the Pump Plant site.

Historically, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics and rubber products; in pigments, dyes and carbonless copy paper and many other applications. Prior to the late 1970s when the production of PCBs was banned more than 1.5 billion pounds of PCBs were manufactured in the United States alone. Out of all of the sediment samples colleted at JBH the only site where PCBs (polychlorinated biphenyls) were detected was in the sample collected at JBH-G-01 or Indian Jack Slough. The PCB Aroclor 1260 was detected in the amount of 42 mg/kg, well below the screening level (Table 3).

Table 3. Organochlorine Pesticides and PCBs (µg/kg) analyzed from sediment samples, Julia Butler Hansen Wildlife Refuge, July 26, 2006

				Site Identifiers							
Analyte, mg/kg		**Screening Level, µg/kg***	**Screening Level, µg/kg****	**JBH-G-01**	**JBH-G-02**	**JBH-G-03**	**JBH-G-04**	**JBH-G-05**	**JBH-G-06**	**JBH-G-07**	**JBH-G-08**
Pesticides	**gamma-BHC (Lindane)**	**10**	-------	< 1.5 ui	< 0.61 u	< 1.0 ui	< 0.30 u	< 0.40 u	< 0.40 u	< 0.35 u	< 0.47 u
	Heptachlor	**10**	-------	< 0.71ui	< 0.33 u	< 0.13 u	0.40 jp	< 0.21 u	< 0.34 ui	< 0.19 u	< 0.51 ui
	Aldrin	**10**	-------	< 1.7 ui	< 2.0 ui	< 0.23 u	< 0.43 ui	< 0.80 ui	< 0.40 u	< 0.35 u	< 0.47 u
	Dieldrin	**10**	-------	< 1.1 u	< 1.7 ui	< 0.45 u	<0.58 u	< 0.76 u	< 0.76 u	< 0.67 u	< 0.91 u
	4,4'-DDE	**6.9**	-------	< 0.37 u	1.4 j	< 0.16 u	0.95 j	2.4	0.94 j	< 0.23 u	< 0.32 u
	4,4'-DDD			< 1.5 ui	< 1.7 ui	< 0.19 u	0.73 jp	2.4 p	< 1.4 ui	< 0.58 ui	< 0.71 ui
	4,4'-DDT			4.4 p	< 1.7 ui	< 0.098 u	0.40 jp	< 0.71 ui	< 1.1 ui	< 0.15 u	< 1.3 ui
	Chlordane	**10**	-------	< 24 ui	< 17 ui	< 2.2 u	< 7.6 ui	< 8.2 ui	< 6.5 ui	< 6.5 ui	< 8.9 ui
PCBs	**Aroclor 1016**	**130**	**120**	< 5.8 u	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u
	Aroclor 1016			< 5.8 u	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u
	Aroclor 1016			< 5.8 u	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u
	Aroclor 1016			< 5.8 u	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u
	Aroclor 1016			< 5.8 u	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u
	Aroclor 1016			< 5.8 u	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u
	Aroclor 1016			42	< 6.6 u	< 2.5 u	< 3.2 u	< 4.2 u	< 4.2 u	< 3.7 u	< 5.0 u

Qualifier Codes:
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
u = The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
i = The MRL/MDL has been elevated due to a chromatographic interference.
p = The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results (25% for CLP Pesticides).
j = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
* Screening Levels based on the Columbia River Dredged Material Evaluation Framework (DMEF) Guidelines
** Screening Levels based on the Sediment Evaluation Framework (SEF) Guidelines

Physical Grain Size

Grain size distribution is one of the most important characteristics of sediment and can be used to determine the ability for soils to absorb pollution. The more clay that is present in soil the more absorption potential the soil has. Grain distribution was determined by using a sieve analysis for gravel and sand determination and a hydrometer analysis for silt and clay analysis. Table 4 and 5 list the particle size determination of each of the eight sediment samples collected at JBH. The sediment sample collected at JBH-G-01 or Indian Jack Slough was made up of 58% gravel and sand and 42% silt and clay. JBH-G-02 or Duck Lake Slough sediment was much less sandy with 23.7% gravel and sand and 76.3% silt and clay. The sediment sample collected at Ellison Slough (JBH-G-03), on the other hand, was a sandy with 97.27% gravel/sand and 2.73% silt/clay. JBH-G-04 or Steamboat Slough was made up of 47.9 % sand and gravel and 52.1 % silt and clay. JBH-G-05 was made up of 35.2 % gravel/sand and 64.8% silt/clay while JBH-G-06 was made up of 30.5% gravel/sand and 69.5% silt/clay. The sample collected at Hampson Slough or JBH-G-07 contained 54.8% gravel and sand and 45.2% silt and clay. And lastly, the sediment sample collected at the Pump Plant site (JBH-G-08) was made up of 38.7% gravel and sand and 61.3% silt and clay.

Table 4. Gravel and Sand Sieve Analysis, Julia Butler Hansen Wildlife Refuge, July 26, 2006

Description	Sieve Size (mm)	JBH-G-01	JBH-G-02	JBH-G-03	JBH-G-04	JBH-G-05	JBH-G-06	JBH-G-07	JBH-G-08
		Particle Distribution in Percent (%)							
Gravel, medium	**4.0**	0.7	2.3	5.5	0.4	11.2	7.4	16.7	0.6
Gravel, Fine	**2.0**	0.9	2.4	4.0	0.1	1.4	0.2	1.0	0.7
Sand, Very Coarse	**1.0**	7.0	2.6	5.0	0.8	2.5	0.6	1.8	4.8
Sand, Coarse	**0.5**	4.1	3.0	25.9	2.3	2.0	1.6	2.9	3.2
Sand, Medium	**0.25**	7.7	3.2	36.4	12.6	2.4	2.0	6.4	5.2
Sand, Fine	**0.125**	22.2	3.8	18.5	20.8	4.9	5.0	9.4	9.8
Sand, Very Fine	**0.063**	15.4	6.4	2.0	10.9	10.8	13.7	16.6	14.4

Table 5. Silt and Clay Hydrometer Analysis, Julia Butler Hansen Wildlife Refuge, July 26, 2006

Particle Diameter (mm)	JBH-G-01	JBH-G-02	JBH-G-03	JBH-G-04	JBH-G-05	JBH-G-06	JBH-G-07	JBH-G-08
	Particle Distribution in Percent (%)							
0.074	9.1	15.2	1.3	13.4	10.6	11.2	0.4	3.0
0.005	25.4	36.3	1.0	29.3	33.4	35.4	33.6	36.6
0.001	7.5	21.6	0.4	9.4	20.0	21.1	11.2	21.7

Total Metals (EPA Methods 6020, 6010B, and 7471A), Total Organic Carbon (EPA Method 9060)

According to the Dredged Material Evaluation Framework (DMEF) arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc are all natural components of soils and sediments of the Lower Columbia River drainage basin, however the concentration of individual metals may vary depending upon additional inputs from human activity or sources. Sediment samples were analyzed for 9 metals including antimony, arsenic, cadmium, calcium, copper, lead, mercury, silver, and zinc. Low levels of some metals were found but did not approach the screening levels under the DMEF and SEF. Antimony was not detected above the MRL (method reporting limit) of 150 mg/kg at JBH-G-03 (Ellison Slough) or JBH-G-07 (Hampson Slough). Antimony as well as Arsenic, Cadmium, Mercury, and Silver were not detected above the MRLs at JBH-G-01 (Indian Jack Slough) as shown in Table 6. Calcium was found in all samples with the highest reading (7,470 mg/kg) at site JBH-G-02 or Duck Lake Slough. This alkali earth element is not a contaminant, is naturally occurring, and as discussed in the water quality section of this report, had no negative impact on the pH of the water within JBH. No metal detected in the sediment samples was measured above the screening limits under the Lower Columbia Framework and Sediment Evaluation Framework and therefore no biological effects are anticipated due to sediment quality. The percent of total organic carbon was also analyzed using the EPA method 9060. Results are listed in Table 6.

Table 6. Total Metals (mg/kg) and Total Organic Carbon (TOC, in percent) analyzed from sediment samples, Julia Butler Hansen Wildlife Refuge, July 26, 2006

		Site Identifiers								
Analyte, mg/kg	**Screening Level, mg/kg***	**Screening Level, mg/kg****	**JBH-G-01**	**JBH-G-02**	**JBH-G-03**	**JBH-G-04**	**JBH-G-05**	**JBH-G-06**	**JBH-G-07**	**JBH-G-08**
Antimony	**150**	--------	0.05 u	0.08	0.04 u	0.06	0.15	0.07	0.04 u	0.06
Arsenic	**57**	**20**	4.09	11.1	0.35 b	2.65	5.08	6.03	4.69	6.21
Cadmium	**5.1**	**1.1**	0.35	0.66	0.04 b	0.32	0.79	0.51	0.31	0.43
Calcium	--------	--------	7140	7470	1770	4690	5700	7450	4180	5710
Copper	**390**	**80**	46.3	54.3	5.12	23.9	31.3	27.8	16.5	29.9
Lead	**450**	**340**	5.49	10.7	1.20	7.32	11.9	9.61	7.57	11.0
Mercury	**0.41**	**0.28**	0.048	0.099	0.007 b	0.055	0.133	0.062	0.046	0.062
Silver	**6.1**	**2.0**	0.122	0.169	0.013 b	0.089	0.140	0.148	0.103	0.137
Zinc	**410**	**130**	84.1	108	16.1	60.4	86.0	82.8	64.0	96.6
TOC, %	**N/A**	**N/A**	3.73	4.05	0.50	1.65	2.79	2.75	3.30	4.50

Qualifier Codes:
u = The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
b = The Analyte was found in the associated method blank at a level that is significant relative to the sample result.
* Screening Levels based on the Columbia River Dredged Material Evaluation Framework (DMEF) Guidelines.
** Screening Levels based on the Sediment Evaluation Framework (SEF) Guidelines.

Conclusions

Sediment samples at eight sites within the Julia Butler Hansen Wildlife Refuge were evaluated in order to determine the presence and nature of contamination in sediments within the refuge. Anthropogenic organic compounds were evaluated using the EPA test methods: 8151A (chlorinated herbicides), 8081A (organochlorine pesticides), and 8082 (polychlorinated biphenyls). These organic compounds were evaluated using the Dredged Materials Evaluation Framework and the Sediment Evaluation Framework screening levels. The chemical analyses indicated only very low levels of contamination in any of the samples. Sediment samples were also analyzed for grain size distribution, total organic carbon and total metals that included Sb, As, Ca, Cd, Cu, Pb, Hg, Ag, and Zn. Out of the metals that have screening limits no metal detected in the sediment samples exceeded those limits. The physical analyses of the eight sediment samples resulted in a range of grain size distributions from course to fine-grained soils. For example the sediment sample collected at Ellison Slough (JBH-G-03) was a sandy with 97.27% gravel/sand and 2.73% silt/clay while Duck Lake Slough (JBH-G-02) was made up of 23.7% gravel/sand and 76.3% silt/clay.

In evaluating the materials represented by all samples in this sampling event no biological impacts are anticipated in the proposed construction plan due to sediment quality.

References

U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. *Dredge Material Evaluation Framework for the Lower Columbia River Management Area.* November 1998 Final.

U.S. Army Corps of Engineers, Portland District, Seattle District, and Walla Walla District, and Northwestern Division; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington Department of Natural Resources; Washington Department of Ecology; Idaho Department of Environmental Quality; National Marine Fisheries Service; U.S. Fish and Wildlife Service. *Sediment Evaluation Framework for the Pacific Northwest.* September 2006 Interim Final.

North American Lake Management Society; Terrene Institute; U.S. Environmental Protection Agency Office of Water, Assessment and Watershed Protection Division. *Managing Lakes and Reservoirs.* 2001 Third Edition.

U.S. Environmental Protection Agency. National Primary Drinking Water Regulations: Technical Factsheets on: (Chlordane, Endrin, Heptaclor and Heptachlor Epoxide, Lindane). Office of Ground Water and Drinking Water. January 1998.

P.A. Vogue, E.A. Kerle, and J.J. Jenkins. "OSU Extension Pesticide Properties Database." web page, http://npic.orst.edu/ppdmove.htm. Revised July 24, 1994.

U.S. Environmental Protection Agency. "Polychlorinated Biphenyls (PCBs)." web page, http://www.epa.gov/pcb/. Revised April 18, 2006.